OF CANOES AND CASTAWAYS: REASSESSING THE POPULATION OF TONGAREVA (PENRHYN ISLAND) AT CONTACT

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Introduction

Toward dawn of an early January morning in 1853, the brig *Chatham*, an American trading vessel out of San Francisco, ran aground on a reef off the southwest coast of Tongareva, Northern Cook Islands. Supposing this isolated and little known atoll to be populated by cannibals, the fourteen crew and passengers were relieved to find themselves physically unmolested. They were conducted ashore and taken into different atoll families with whom they were variously destined to stay for between three and fifteen months. Among the castaways was E. H. Lamont, a trader who had chartered the *Chatham* on its ill-starred voyage and who spent almost exactly a year ashore before being rescued to Rarotonga. There, he began work on an account of his experiences of atoll life (Lamont 1867), which Buck properly describes as "one of the best narratives of first-hand contact with a group of Polynesian people before they were influenced by western culture" (1932:8; see also Maude 1968: 173). Supplemented with more fragmentary records (especially Chamisso 1821, 3: 217-219; Choris 1822:14-16; 1826: 20; Johnson 1841; Kotzebue 1821, 1:162-168; Sinclair 1841; Snow 1969 [1853]; Wilkes 1845), Lamont's work forms the foundation of a contact-era ethnography that is arguably more precise and comprehensive than that of any other Polynesian atoll (Buck 1932; Campbell 1985).

Pacific Studies, Vol. 11, No. 1--November 1987

It is unfortunate, therefore, that the population of Tongareva early in 1853--the year commonly taken to mark the first significant European contact[1] --is less certainly known than is the contact population of most other atolls. Norma McArthur, in her now-classic investigation of Pacific demography, inclined toward a figure of 500 to 700 for its "mid-century population" (1968: 185-186, 190).[2] In reaching this conclusion, she dismissed as "improbable and baseless" an undated estimate of 1,300 inhabitants by the LMS missionary, William Gill (1856), and relied instead on a claim by his colleague, Royle (1865), that there had been 700 people before the arrival of Peruvian slavers in July 1862; and on William Wyatt Gill's (1863) later findings that in early 1863 there were only 88 people on the atoll, with a further 130 absent in Tahiti and "more than 250" taken by the slavers to Callao. Further research now puts the number recruited by the Peruvians at approximately 472 (Maude 1981: 11)) thus supporting Royle's figure of 700.

Since McArthur's work, however, further data have come to light that form the basis of a much higher estimate of the contact population. Following his escape from the atoll in a makeshift boat, the *Chatham's* captain, George Snow, reported the presence of "about 2500 natives" (Snow 1967 [1853]:509; Wheeler 1967 [1854]:512). Meanwhile Lamont, rescued to Avarua, Rarotonga, obliged the inquiries of LMS missionaries by estimating the population at "about 1500 or 2000" (Pitman 1853/1854). Taking the mean of these latter figures, Andrew Campbell has recently suggested "a working estimate" of 1,750 for the contact population (1985:33), arguing that Lamont's figures are preferable to Snow's because Lamont traveled extensively around the atoll and was there almost a year compared to Snow's eleven weeks.[3]

These two, widely differing estimates pose obvious and fundamental problems for the interpretation of Tongarevan history and contact-era culture. To begin with, they lead to radically different conclusions about the depopulating effects of Western contact. In early 1862, Tongarevans numbered no more than about 690 (W. Wyatt Gill 1863; Maude 1981: 11). McArthur's estimate therefore implies little or no depopulation, whereas Campbell's suggests a spectacular loss of nearly two-thirds in less than a decade. Campbell attributes this decline to introduced disease and widespread famine (1985:33-36), and there is evidence for the presence of both during this period (Mrs. Buzacott n.d., cited in Campbell 1985: 34; A. Buzacott 1858; W. Wyatt Gill 1862; 1863; 1876: 11-12; 1883; 1885:31, 127). On the other hand, the only documentary records of ***deaths*** from either cause are of an unspecified number apparently attributable to disease introduced by the *Cha-*

tham castaways (Lamont 1867: 174, 264-266) and a death caused by influenza sometime between 1854 and 1858 (A. Buzacott 1858).[4]

The two estimates also lead to significantly different interpretations of those aspects of contact-era social life--such as warfare, economic structure, and political complexity--that may be influenced by demographic factors. The discrepancies are therefore of particular concern to students of archaeology, cultural ecology, and cultural evolution, who have increasingly come to recognize the Pacific islands as unique "laboratories" for the comparative study of cultural and ecological processes and whose analyses frequently incorporate demographic variables (for example, Cordy 1986; Goldman 1970; Kirch 1984; Sahlins 1958). The problem is compounded by the unfortunate comparative implications of the two estimates. With a land area of 9.73 square kilometers (Survey Dept. n.d., cited in Campbell 1985:29), Tongareva's contact population density, by Campbell's estimate, was about 180 per square kilometer, among the highest of any Pacific atoll of comparable size.[5] By contrast, McArthur's figures yield a density of only 50 to 70 per square kilometer, one of the lowest in the entire Pacific.

Until these differences are resolved, then, both the particular and cross-cultural value of the otherwise exceptional Tongarevan data remain seriously undermined. Toward resolution, this article examines and analyzes two events from the atoll's early contact history in which counts were made of canoes and inhabitants "coming off' the atoll to visiting vessels. While these data yield no estimates of the atoll's total population, they do provide a reliable basis for its *conservative* estimation. The results indicate that Campbell's 1,750 rather than McArthur's 500-700 estimate is the more probable figure for the mid-century population, a conclusion corroborated by internal evidence in Lamont's account. In addition, there are grounds for supposing that Campbell's estimate is more definitive than this and other evidence warrants, and I therefore suggest that the atoll's contact-era population is more appropriately set at 2,000±500.

The Visits of the *Rurick* and the *Porpoise*

The first European sighting of Tongareva occurred in poor weather on the morning of August 8, 1788, when the crew of H.M. Transport *Lady Penrhyn* "saw a low flat island, bearing east to north east seven or eight miles distant" (Watt 1789: 244). It was another 28 years, however, before Europeans first made contact with the inhabitants. Cruising in a northwesterly direction, the Russian exploring vessel *Rurick*, under the

command of Lieutenant Otto von Kotzebue, sighted Tongareva at three o'clock on the afternoon of April 30, 1816. By five o'clock, the vessel was lying three miles "from the southern part of this group," but nightfall prevented any attempt at landing. The ship had apparently been seen on shore, but no canoes came off (Kotzebue 1821, l: 162).[6]

The next morning, Kotzebue moved the ship "under the lee of the group" (ibid.; almost certainly, this would mean the western side of the atoll: see Campbell 1985: 39). At eight o'clock, "in still water, only a couple of miles from the shore," he noticed "many people running about, others hastily pushing their boats from the shore, while others, from the more distant islands, were already making their way towards us" (Kotzebue 1821, 1:162). The vessel lay to and Choris, the ship's artist, counted 14 canoes approaching (1822: 15). A short distance from the ship, they halted, and the occupants "commenced a song, with quite a sorrowful melody" (Kotzebue 1821, 1: 163). Following a brief period of exploratory barter, a count revealed 26 boats crowded around the ship, Kotzebue indicating that they contained "three hundred savages" (ibid.). Toward noon, bad weather prompted him to move on, but before departing he counted "thirty-six boats, with three hundred and sixty men, whose numbers would have encreased, if we had remained any longer, as already we saw several canoes coming up to us" (ibid. : 167).[7]

There is some disagreement on the numbers in these canoes. Chamisso counted "from seven to thirteen people" in each (1821, 3:217). Choris claimed *"de six à treize hommes,"* but went on to say that some carried as many as 20 (1822: 15; 1826:20).[8] Kotzebue reckoned that they carried "twelve men conveniently" and had "from twelve to fifteen men on board" (1821, 1: 163, 166), though the latter hardly agrees with his estimates that 26 canoes contained a total of 300 people and 36 canoes had 360 men on board (ibid. : 163,167). Withal, though, it seems safe to conclude that there were at least 10 people on average in each canoe.

Virtually all of the canoeists were male. Chamisso noted "women in three boats only" (1821, 3: 218); any doubts over whether he meant three women or three canoes full of women are dispelled by Kotzebue's comment that "I cannot judge [of the appearance] of the women, as I only saw two of them, and they were old and very ugly" (1821, 1: 165).[9] It appears, then, that at least 257 males gathered around the *Rurick* at the time of the initial count (297 if Kotzebue is to be believed) and at least 357 males at the time of the final tally.

The second European visit of importance to this study was that of the *Porpoise*, a brig of the United States Exploring Expedition under com-

mand of Lieutenant Commandant Ringgold. The ship came upon the island on the afternoon of February 15, 1841, and, according to Wilkes's official account (1845:296),[10] stood off and on the western coast all night. Shortly after sunrise on the sixteenth, a large number of canoes were seen starting from the shore, By seven o'clock, the first two had reached the ship, and around 7:20 **A.M.,** Johnson, the ship's lieutenant, noted that four were now alongside, each containing "from 6 to 16 persons," totaling "about 40 natives" (Johnson 1841). At about this time, Sinclair, the acting master, reached the deck to find, in addition to these "four or five" canoes, "about fifteen more approaching" (1841). Shortly thereafter he noted, "The canoes now in sight, about twenty, contained from 200 to 250 natives" (ibid.), a number that accords with Johnson's estimate of "two hundred twenty five" (1841).[11] Of these, no more than two or three were women (Sinclair 1841; Wilkes 1845:298). It seems, then, that around 225 males had started for the *Porpoise* shortly after sunrise and had arrived within about an hour to an hour-and-a-quarter.[12]

The Contact-Era Population of Tongareva

If N is taken to be the shipboard count of the males around the *Rurick* or the *Porpoise,* if *P* is the proportion of the atoll from which these males were drawn, and if *R* is their ratio to the total population of this atoll proportion, then Tongareva's total population, *T,* is approximately given by the equation

$$T = \frac{N}{P \times R} \qquad (1)$$

Unfortunately, neither *P* nor *R* are known for either visit, but measures can be derived that are almost certainly *over*estimates of each parameter, which, in turn, will yield *conservative* estimates of *T,* the total population.

If the males around the *Rurick* and the *Porpoise* were drawn from the entire atoll, then *P* would assume its maximum value of unity. However, two lines of argument suggest that *P* was at most a half and quite probably no more than a third. The first argument is based on the amount of time it would take the Tongarevans to reach the two vessels in question. Tongareva is one of the larger atolls in the Pacific. At its narrowest

extent, the lagoon is about 7 miles across; at its widest some 15 miles. Although it was possible to walk around much of the atoll at low tide, the fleeter mode of transport was outrigger canoe.

Tongarevan canoes were made of ***Cordia subcordata*** planking sewed together with cord and plugged with coconut husk, a construction with an inconvenient tendency to leak, necessitating constant bailing (Lamont 1867: 151-152, 195). These canoes were usually paddled, though a disposable coconut-leaf sail was sometimes employed before a favorable wind (Chamisso 1821, 3: 219; Lamont 1867: 151-152, 242-243). Although some Hawaiian canoes could apparently reach 11 to 12 miles an hour under paddle (Parsonson 1963: 27, n. 61), most Pacific canoes--under paddle or sail--seemed unable to reach much more than half that speed under sustained conditions (Gladwin 1970: 99; Patterson 1967 [1817]:103; Wilson 1968 [1799]: 379). The Tongarevan canoe was apparently no more swift. Lamont provides several observations on intra-lagoon travel that indicate an average speed of about 4 mph (3.5 knots) (1867: 196, 303, 243, 246), though one trip may have averaged as much as 5.5 mph (4.8 knots)--a war canoe paddled by 30 warriors took "nearly two hours" to travel "some eight miles" between the islets of Mangarongaro and Tokerau in hot pursuit of another vessel (ibid. : 195).[13]

These figures are important for they indicate that even if all of the atoll's males had set off for the *Rurick* or the *Porpoise* at the same time, and even if the two vessels were located off the narrowest part of the atoll, people from the far side would not start to arrive until, at the very least, one-and-a-quarter to one-and-a-half hours after the first arrivals. The *Rurick's* final count of 357 males was taken shortly before noon, so the possibility that most of the atoll's males had then arrived cannot be discounted. However, the accounts leave little doubt that the initial tally of 26 canoes occurred well within an hour-and-a-quarter of the first arrivals. For their part, observers aboard the *Porpoise* counted about 225 men setting off for the ship well within an hour-and-a-quarter of one another. Now, if Lamont's data are reliable, the atoll's population was fairly evenly distributed around its cays in the early part of the nineteenth century (1867: 287).[14] It therefore follows that the 225 men around the *Porpoise* and the 257 or so males around the *Rurick* represented, *at most,* the male population of only one-half the atoll. In other words, *P* can be taken as «0.50.

An objection, of course, can be made that the male inhabitants of the atoll, having glimpsed the vessels the previous evening, had all gathered

together during the night and had come off en masse at dawn, a circumstance that would invalidate the above value of *P*. This, however, seems improbable on three grounds. First, the inhabitants of the far side of this large atoll quite probably never saw the visiting vessels. As Lamont (1867: 143) indicates, the far shores were only visible on a clear day, and palms on the intervening islets would, in any case, tend to obscure vessels in the ocean beyond. Second, the organization of such a massing would be seriously hampered by the difficulties of predicting the vessels' courses during the night and their movements at dawn. In any case, there is evidence that the islanders were reluctant to travel abroad at night for spiritual reasons (ibid. :251, 294).

Third, and perhaps most important, a near-perpetual state of enmity existed among the islets, which would have made such a hastily convened gathering difficult and precarious. According to Lamont (1867: 169, 225, 230, 262, 341; see also Campbell 1985: 73-74), the islets were united into three largely endogamous political "alliances."[15] Mutually antagonistic toward one another and frequently at war, these groups kept very much to themselves, coming into peaceful contact only after elaborate ceremonial preparations and declarations (Lamont 1867: 133-143). In fact, the existence of this enmity strongly suggests that the men around the *Rurick* and the *Porpoise* would be drawn solely from the alliance in the immediate vicinity. They would therefore represent about one-third at most of the atoll's total male population.[16] If this line of argument is accepted, then, *P* can be taken as «0.33.

The second factor needed to convert the counts from the *Rurick* and the *Porpoise* into total population is some estimate of *R,* the ratio of counted males to the total population of the atoll proportion from which they came. None of the observers aboard the *Rurick* and the *Porpoise* made age estimates of the men in the surrounding canoes. Those aboard the *Rurick* referred only to "men" and "hommes" as opposed to "boys" or "children," but such omissions do not necessarily bespeak the presence of adults alone. By contrast, Sinclair, aboard the *Porpoise,* specifically mentions the presence of "boys," whom he seemed to distinguish by their lack of beard (1841). Given these age-related uncertainties, *R* would certainly be overestimated (and the atoll's total population therefore underestimated) if it were assumed that *every* male from proportion *P* of the atoll had come off and been counted. Since there is no evidence of infanticide--selective or otherwise--on Tongareva, and since women and children were always spared in war (Lamont 1867: 133; Moss 1889: 106), this assumption yields a value of *R* «0.50.

It seems improbable, however, that infants and toddlers would be taken out to unfamiliar vessels without their mothers and without any shipboard source mentioning their presence. If it is supposed, then, that the age of the youngest male in the canoes was 5 years old, some idea of the difference this would make to *R* can be obtained by assuming the Tongarevan age-sex pyramid was approximately symmetrical and triangular, which would correspond to a population close to stability in demographic sense and nearly stationary in numbers (Smith and Zopf 1976). By simple geometry, the ratio, *R,* of males *Y* years old or older to total population for such an age-sex pyramid is given by the equation

$$R = \frac{(L-Y)^2}{2L^2} \qquad (2)$$

where *L* is the age in years of the oldest Tongarevan inhabitant. Taking *L* as unlikely to exceed 80 (the larger the value of *L,* the larger will be *R,* and the more conservative will be *T),* and setting *Y* at 5, yields *R* = 0.44. This value, in fact, changes only slightly even if the deviation from a triangular pyramid is considerable. Needless to say, if Tongare van birth rates were relatively high, as seems quite possible, the age-sex pyramid would be concave in shape, so that a value of 0.44 would over estimate ***R*** (and underestimate *T)* even further.[17]

Combining these various values of ***P*** and ***R*** into total population estimates, ***T,*** yields table 1. These figures indicate that even in the improbable eventuality that every male on the entire atoll, from the youngest to the oldest, had come off to the *Rurick* and was included in the final count, the population of Tongareva would still be slightly in excess of 700, McArthur's maximum figure for the precontact population. If every male except infants and toddlers had come off, the population

TABLE 1. Estimates of Tongareva's Total Population *(T) (Rurick and Porpoise)*

		P=l.OO		*P*=0.5O		*P*=O.33	
	N	*R*=0.50	*R*=0.44	*R*=0.50	*R*=0.44	*R*=O.5O	*R*=0.44
Rurick (initial)	257	514	584	1,028	1,168	1,558	1,770
Rurick (final)	357	714	811	1,428	1,623	2,164	2,459
Porpoise	225	450	511	900	1,023	1,364	1,550

Sources: Chamisso 1821; Choris 1822, 1826; Johnson 1841; Kotzebue 1821; Sinclair 1841 Wilkes 1845.

would have been more than 800. Needless to say, it seems highly probable that no more than half of the atoll could have reached the vessels in time for the initial counts, indicating that the population was at least 1,028 in 1816 (1,168 if infants and toddlers were left ashore) and at least 900 in 1841 (1,023 if infants and toddlers were left ashore).

Even these, though, are highly conservative estimates. They assume that, regardless of existing states of enmity, every single male, from the newest born (or from age 5) to the very eldest, who could possibly be carried to the *Rurick* or the *Porpoise* in time to be counted, came out. If slightly less conservative assumptions are adopted, and it is assumed that every single male over the age of 5 from a single Tongarevan alliance came off, then the 1816 population was at least 1,770 and possibly 2,459 or higher, while the 1841 population was at least 1,550. These figures compare favorably to Lamont's estimate of the late 1853 population.

McArthur's estimate of no more than 700 as Tongareva's mid-century population thus seems highly improbable unless the atoll had undergone significant depopulation between the earlier half of the century and 1853 and unless Lamont's and Snow's estimates were badly in error. Unfortunately, there is no independent corroboration for the accuracy of these latter sources, but internal evidence in Lamont's work, though less substantial than the data from the *Rurick* and the *Porpoise,* lends them some credence.

The Wreck of the *Chatham,* 1853

Lamont's writings include two items of information that can be used as a check on the accuracy of his and Snow's population estimates. About halfway through his stay, while touring the atoll to assess its pearl-shell resources, he was present when an invasion fleet from Sararak [Sarereka] descended on the islet of Motunono. The fleet, he observed, comprised "several canoes, containing about one hundred warriors" (Lamont 1867: 289). Given the excitement preceding an attack, such an estimate is of dubious accuracy, but its value lies in the identity of the invaders. Lamont spent most of his year ashore living among the Sararakians and he was therefore well acquainted with their fighting strength. The figure of 100 warriors, then, may not be an accurate estimate of the invading force, but it is unlikely to overestimate the total number of warriors that Sararak could muster.[18]

A second fragment of evidence centers on the islet of Matunga [Motuunga]. Lamont happened to be on the islet when news arrived that its

enemies were preparing for war. The Matungans, he wrote, immediately began to refurbish "several canoes," amongst which were "three large war canoes" (Lamont 1867: 336). The construction and maintenance of Tongarevan canoes required considerable investments of material, time, and labor; war canoes were particularly demanding because they were larger than those used in day-to-day transportation and were more frequently dismantled and recaulked (Campbell 1985: 82; Lamont 1867: 151-152, 237, 336). It is therefore plausible to suppose that the Matungans would build or refurbish no more fighting vessels than they needed. Lamont saw 30 warriors in one war canoe (1867: 195) and elsewhere noted another three carrying a total of 60 warriors into battle (ibid. : 346).[19] Accepting the more conservative of these figures and ignoring the smaller canoes also being refurbished, this evidence suggests that at least 60 warriors lived on Matunga.

These figures can be converted to total atoll populations with the methodology outlined above. Assuming that *all* postpubescent males were warriors and that the Tongarevan age-sex pyramid was approximately symmetrical and either triangular or concave, *R* becomes « 0.33.[20] *P,* the proportion of Sararakian and Matungan warriors to all Tongarevan warriors, is estimated as follows. At least 121 different Tongarevans can be unambiguously distinguished in Lamont's account; of these, 24 were from Sararak and 15 from Matunga. If ambiguous distinctions are allowed, 156 different Tongarevans are distinguishable, of whom 26 are from Sararak and 20 from Matunga. These figures yield *P* values of 0.17-0.20 Sararakians and 0.12-0.13 Matungans to every Tongarevan. Now, Lamont spent most of his stay on these two cays; Sararak was his first home, Matunga his second. It follows that their residents would figure disproportionately in his account, so that using these figures for *P* will overestimate the actual proportion of Sararakian and Matungan population to total atoll population and thus contribute to conservative estimates of Tongareva's total population, *T.*

Combining these values of *P* and *R* into total population estimates, *T,* yields table 2. In light of the highly conservative assumptions built into

TABLE 2. Estimates of Tongareva's Total Population *(T)* (Lamont)

	N	*P*	*R*	*T*
Sararak	100	0.17-0.20	0.33	1,515-1,782
Matunga	60	0.12-0.13	0.33	1,399-1,515
Sararak & Matunga	160	0.29-0.32	0.33	1,515-1,672

Source: Lamont 1867.

these calculations, these figures must be considered to corroborate Lamont's and Snow's estimates that Tongareva's 1853 population was in excess of 1,500 as opposed to McArthur's claim that it did not exceed 700.

Conclusion

The balance of the evidence presented here must weigh strongly in favor of Campbell's "working estimate" of 1,750 Tongarevans at contact (based on Lamont's "1500 or 2000") and against McArthur's 700 (based on later missionary sources). Unfortunately, the data do little to discriminate the accuracy of Lamont's 1,500-2,000 from Snow's claim that there were 2,500 inhabitants. If, for example, the males in the canoes around the *Rurick* indeed came from only one of the three alliances on the atoll (that is, $P \leqslant 0.33$), and if they included only a small proportion under the age of 15 (that is, $R \leqslant 0.33–0.44$), then the population of Tongareva would be more accurately estimated at 2,400 to 3,200. And if the population was at these levels in the early part of the century, there is no reason why they might not be at similar levels thirty to forty years later.

This difficulty in discriminating between the two *Chatham* estimates is unfortunate since there is reason to question Campbell's dismissal of Snow's figure of 2,500. Campbell, it will be recalled, preferred Lamont's figures because Lamont had spent more time on the atoll and had traveled more extensively around it. But these arguments neglect several important points. Though Snow's sojourn was only a quarter of Lamont's, he was present during the first fortnight, when most of the atoll's inhabitants gathered ceremonially to welcome the new arrivals. Moreover, while it is unclear if he circled the entire atoll, he did tour it extensively to reconnoiter the pearl beds (Lamont 1867: 223). More important yet, in contrast to Lamont's figures, which evidently refer to the population at the time he *left* the island, Snow refers to a period *before* diseases and wars attributable to the castaways had seriously affected Tongarevan population levels. The Tongarevans blamed the *Chatham's* crew and passengers for two disease epidemics that broke out during their stay, accusations that seem justified by their epidemiology (Lamont 1867: 174, 264-266). The first epidemic was not serious, proving fatal only "in one or two cases"; "few died, and these only children" (ibid. : 174, 266). But the second was more deadly, "carrying off their warriors, their best men." The islanders claimed they "had never any sickness like this before we came" (ibid.:266)--on the most

affected islets, the number of funeral feasts was sufficient to deplete coconut reserves seriously (ibid.: 273). To add to these losses, the *Chatham's* crew and passengers succumbed to the frequent propensity of castaways to feud among themselves, a state of affairs that sucked the Tongarevans into warring that otherwise they might have been spared (ibid. :262, 313-314, 344-347).

Snow, however, left the island on March 22 or 24, after the first, mild epidemic but before the second, serious outbreak, and before the European presence had begun significantly to influence the level of violence. In contrast to Lamont's estimate, then, Snow's figure refers to a period before European influences on population had become pronounced, and, in the absence of further evidence, there seems as much or more reason to prefer his 2,500 to Lamont's 1,500 to 2,000. Campbell's figure of 1,750 thus seems more precise than the data warrant, and a more appropriate estimate would perhaps be 2,000 ± 500.[21]

Such an estimate significantly reduces the current uncertainty about Tongareva's contact population. It unambiguously establishes the atoll as one of the most densely populated in the Pacific for its size range, a conclusion with obvious implications for the interpretation of Tongarevan warfare and social structure. It thereby renders convincing the comments of early visitors such as Kotzebue that the population "appeared to me so numerous, in proportion to the island, that I cannot, even now, think how so many can find subsistence" (1821, 1: 162-163; see also Johnson 1841). And, perhaps most significantly, it leads to the ineluctable conclusion that the population of Tongareva suffered a spectacular decline during the period 1853-1862.

NOTES

This paper stems from an ongoing research project, based on fieldwork in Melanesia and archival research on Polynesia, on the relationships between population and political evolution in the Pacific. I am grateful to the Richard Lounsbery Foundation and the American Museum of Natural History for support during its writing and to Bob Carneiro, Harry Shapiro, and two anonymous reviewers for their comments on earlier drafts.

1. The shipwreck of the ***Chatham*** and the marooning of its crew and supercargo is commonly taken as the date of the first significant European contact with Tongareva. Prior to that year, the atoll's reputation as the abode of cannibals had kept foreign visits to a minimum. These include the brief visits of the *Rurick* in 1816 (Chamisso 1821; Choris 1822; 1826; Kotzebue 1821), the ***Peruvian*** in 1827 (Anon. 1967 [1828]: 495-496), the *Glide* in 1830 (Endicott 1923: 30-31), the *Ceres* in 1836 (Cleland 1834-1837), the *Franklin* in 1840 (Riddell 1837-1841), the ***Porpoise*** in 1841 (Johnson 1841; Sinclair 1841; Wilkes 1845), the *Roman* in 1844 (Shockley 1843-1845), the ***Moctezuma*** in 1845 (Tower l844-1847), and

the ***N. P. Tallmadge*** in 1850 (Milford 18481851). With the exception of the ***Moctezuma,*** which lay offshore for two days, none of these contacts lasted for more than a few hours (see Campbell 1985 for a summary). Almost certainly, however, there were other visitors, though their records have yet to be discovered.

2. Buck (1932:9) and Alkire (197883) estimate the contact population to have been "about 2000" and "from 600 to 1200" respectively, but these figures are little more than educated guesses.

3. The ***Chatham*** ran aground between the fifth and seventh of January. Snow departed on either March 22 or 24 (Anon. 1967 [1854]: 518, 519; Lamont 1867: 104; Snow 1967 [1853]:507,509; Wheeler 1967 [1854]:513).

4. Campbell also attributes the decline to emigration (1985: 33-35), but it is possible that the figures for 1862 take these migrants into account.

5. Compare with the following approximate contact-era densities (per square kilometer) for Pacific atolls in the 5 to 15 square kilometer range: Beru 160, Butaritari 110, Manihiki-Rakahanga 130, Marakei 125, Onotoa 125, Ontong Java 170, Puka Puka 120, Vaitapu 80 (Bayliss-Smith 1974: 280,286; Bedford et al. 1980: 231,235,238; McArthur 1968:187,188; Maude 1981:192; Carter 1984:469; Wood and Hay 1970:5).

6. Choris, the ship's artist, has: ***'Au coucher du soleil, on aperçut des hommes sur une pointe sablonneuse de la côte septentrionale du groupe"*** (1822: 15; emphasis added). The ship's course, however, indicates that Choris had confused north and south.

7. Chamisso confirms the latter canoe count (1821, 3: 217), a significant point since neither source apparently consulted the other in producing their reports (ibid., 3: 436).

8. Choris's engraving of the scene (1826: Plate 11) depicts two canoes with five crew, one with seven, one with eight, one with about nine, one with eleven or twelve, and one with fourteen. Artistic license is apparent, though, for the size of the crews increases from the foreground to the background.

9. Only one woman can be identified in Choris's engraving of the scene (1826: Plate 11).

10. Wilkes was aboard the ***Vincennes*** and did not visit Tongareva himself: his official account is compiled from records kept by the ***Porpoise.***

11. These figures yield 10 to 13 people per canoe, which accords with the numbers estimated by the ***Rurick.*** As with the ***Rurick,*** two canoes were noted to be large, with "15 or 16 men in each" (Sinclair 1841). Five years earlier, Cleland (1834-1837) had noted "11 or 12 men and women" in each of eight or nine canoes alongside.

12. On February 16, the sun rises on Tongareva at approximately 6:02 **A.M.** local time (AENA).

13. The distance between the islets of Mangarongaro and Tokerau varies from about 8.5 to 10.7 miles because of their length and orientation (Wood and Hay 1970:59). To err on the side of a conservative estimate of ***T,*** the latter figure has been used in deriving the canoe speed of 5.5 mph (4.8 knots).

This speed is almost certainly an overestimate. Equipped with sail, Tongarevan canoes seem to have been as fast as or faster than when paddled by a large complement (Lamont 1867: 303). Yet a sailing canoe still took "about two hours" over the same course (ibid.: 246), while another took "about an hour and a half" to travel from the islet of

Tepuka to the islet division of Hakasusha [Hakasusa] (ibid.: 243), speeds of about 4.0 to 4.2 mph (3.5 to 3.6 knots). Following missionization, several Europeans described their trips between the islets of Omoka and Te Tautua in European or native vessels (Chalmers 1872; Cullen 1899; Lawrence 1897, 1900, 1901). The fastest time, in the ship's boat of the ***John Williams*** under "a strong fair wind," was about 5.8 mph (5 knots) (Lawrence 1897).

14. Almost certainly there were localized fluctuations in this distribution. During Lamont's stay, for example, the islet of Etuchaha [Atutahi] was particularly populous (1867: 278), while Tamata [Temata], Muta Mono and Hakasusha were comparatively underpopulated (ibid. : 125, 282, 287). There is no evidence, however, of systematic population variations around the atoll.

15. Lamont's data (1867: 287) suggest four alliances existed early in the nineteenth century. However, to arrive at a conservative estimate of the total population, the presence of three alliances only is assumed in the following calculations.

16. Wrecked "some two or three hundred yards" from the southwest coast of Tongareva, the ***Chatham*** was apparently visited by people drawn from only a part of the alliance centered on the islet of Mangarongaro (Lamont 1867).

17. By way of comparison, the equivalent ratio for the Cook Islands as a whole in 1936, before large-scale modern emigration, was also 0.44. For the atolls of the Northern Cooks, which include Tongareva, the ratio was slightly less than 0.43 (McArthur 1968: 203, 209). In 1951, Nukunonu, one of the Tokelau group with very limited emigration at the time, had a ratio of 0.43 (Hooper and Huntsman 1973: 385, 391. Birth rates on these atolls had probably increased over precontact levels, but the consequent effects on R would be counteracted to some degree by the cessation of warfare.

18. There is some confusion in the literature over the identity of Sararak [Sarereka] (Buck 1932:5; S. P. Smith 1889: 90). Lamont makes it quite clear, though, that it comprised the islet divisions of Mangarongaro, Tahiti [Tevete], and Hakasusha (Lamont 1867: 125; see also Campbell 1985: 73, 85). By the time of the descent on Muta Monu, Hakasusha had become a "separate kingdom" (Lamont 1867: 277) and therefore may well have been uninvolved in the attack. Nevertheless, to insure an overestimate of P (and hence a conservative estimate of the total atoll population, T), the following calculations assume Hakasusha was part of the force.

19. According to Snow (1967 [1853]:508-509), Tongarevan war canoes were "from fifty to seventy feet in length, and will carry from one to two hundred persons." This claim is not supported by other observers and seems improbable: such a carrying capacity would be rivaled only by the double-hulled vessels of large Polynesian islands like Tahiti (Oliver 1974, 1: 401).

20. Calculated from equation 2, assuming $L = 80$ and $Y = 15$. By comparison, the value of R for the 1936 Cook Islands population was 0.30, for the Northern Cooks slightly less than 0.29 (McArthur 1968: 203, 209); and for Nukunonu, in 1951, 0.28 (Hooper and Huntsman 1973: 385,405). These data suggest that a value of $0.33\dot{}$ is likely to overestimate R (and thus underestimate T), though the cautions raised in n. 17 also obtain here.

Lamont's account allows the population of only two settlements to be established with any confidence. Together, they comprised three adult males, four "boys," and four

females, yielding an ***R*** value of approximately 0.27 (Lamont 1867: 119-157 passim, 162-166).

21. The Tongarevan diet consisted predominantly of fish and coconut. It might therefore be wondered whether an atoll with an area of just 9.73 square kilometers could support such a population. As Campbell points out, though, the Tongarevan reef (and hence its marine resources) was larger than that of Rarotonga (1985: 35), which had a contact population of perhaps 6,000-7,000 (McArthur 1968: 164). My own calculations suggest that Tongareva's coconut resources were compatible with a population somewhere in the range 850-3,800.

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